

## Non-destructive Testing Scanner

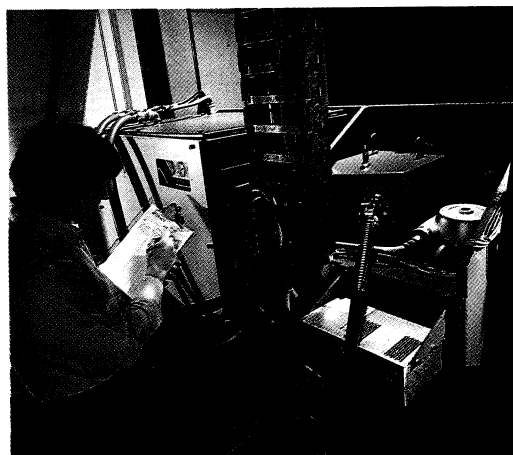
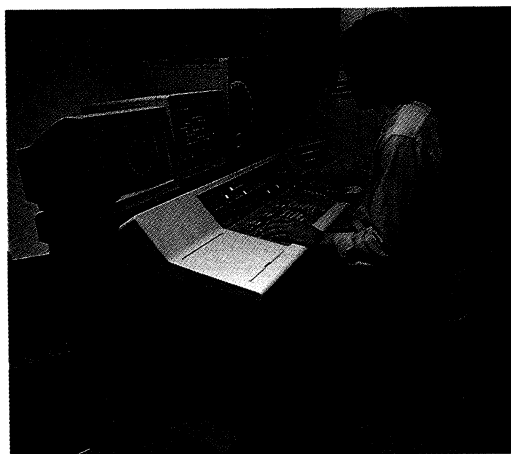
Computed tomography, also known as CT or CATScan, is an established medical diagnostic technique for comprehensive body scanning. It incorporates digital image processing technology that traces its origin to NASA research and development performed as a prelude to the Apollo Lunar Landing Program.

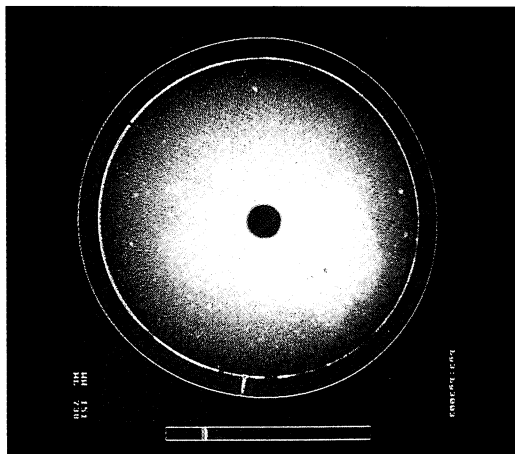
The technology that originated in an aerospace program has come full circle with a new aerospace—or general industrial—adaptation called the Advanced Computed Tomography Inspection System, or ACTIS. Where the medical version of CT scans the human body for tumors or other abnormalities, the ACTIS system finds imperfections in aerospace structures and components, such as castings, assemblies, rocket motors and nozzles.

Developed for Marshall Space Flight Center by Bio-Imaging Research, Lincolnshire, Illinois, ACTIS is described by its developer as the most versatile CT scanner available for non-destructive testing applications. Marshall is using its system to test rocket motor assemblies and other critical components. Boeing Aerospace & Electronics, Kent, Washington purchased the first industrial use model and is using it to learn more about materials and processes, particularly in the field of composite materials.

ACTIS is a variable geometry system. Where most large scanners have fixed distances between the radiation source and the detectors, ACTIS source and detectors can be moved closer together or farther apart to optimize the geometry for different sizes of test objects. In addition, ACTIS can support three separate radiation sources operating over a wide range of voltages; it also has a large number of detectors in unique focusing assembly, which provides greater x-ray collection efficiency and more image data. This combination—variable geometry, three sources and focusing detectors—makes ACTIS cost-effective for a broad range of applications. The system can scan anything from very small turbine blades to large rocket assemblies.

At top right is the ACTIS console, from which the user can set scan parameters, initiate scan-





ning, create, retrieve and store data, and control the display and analysis of images. In the middle photo, opposite page, is the gantry control processor, which provides local control of the scanner gantry while test objects are being loaded and unloaded. The bottom photo opposite illustrates the three separate radiation sources. At immediate left is a CT color image (ACTIS also provides monochrome imagery) of a cross section of a rocket motor gas generator; the bright yellow spots in the orange background (near the perimeter) are small voids that indicate anomalies.

Photo below illustrates one of a number of Boeing applications of the ACTIS system: it is being used in non-destructive evaluation of aircraft components. Boeing's special use of the system is in analysis of composite materials, crucial to the company's advances in missile and aircraft design. Computerized tomography bids to become increasingly important with industry's anticipated expansion of composite use.

ACTIS has already proved important to Boeing Aerospace & Electronics. The company has won several NASA/USAF research and development contracts for component inspection and test due to the expertise of the ACTIS-equipped Physics Group.

Boeing's interest in CT was sparked by a problem early in the development of the company's Inertial Upper Stage (IUS), used by NASA and the Air Force to boost satellites to higher orbits after their initial delivery to low Earth orbit. When concerns arose over IUS' nozzle exit cones, Boeing technicians purchased inspection time at medical facilities to examine suspect exit cones with CT scanners. That led to the company's purchase of its own ACTIS system. All IUS cones are routinely scanned to verify product quality when they leave the factory.

